FEB 25 Entd
GROSVENOR LIBRARY
BUFFALO, N. Y.

J4008

ENGINEERING EDUCATION

Bulletin of the

Society for the Promotion of Engineering Education

B.O.X

VOL. XIV LANCASTER, PA., SEPTEMBER, 1923 NO. 1

Just Published

SMITH'S

ENGINEERING KINEMATICS

By WILLIAM GRISWOLD SMITH

Associate Prof[illegible] of Mechanical Drawing, Northwestern University

282 pages, 6x9, 341 illustrations, $3.00

A sound textbook on kinematics that draws its examples from actual engineering practice and relates the subject in the student's mind to his future work.

This new text on kinematics aims to show the student what can be *done with the science.* Throughout the book there is a close and obvious relation of the material to actual engineering problems and conditions.

The fundamental principles of motion, its laws, its conversion and its transfer are thoroughly treated but special emphasis is placed on the applications of these principles to the design of the innumerable agencies for transmission, transportation and production.

OTHER NEW McGRAW-HILL TEXTS

Weiss—
Practical Railway Maintenance
349 pages, 6x9, illustrated, $3.50.

Stansfield—
Electric Furnace for Iron and Steel
453 pages, 6x9, illustrated, $5.00.

Besson—
City Pavements
421 pages, 6x9, illustrated, $5.00.

Hudson and Squire—
Elements of Graphic Statics
91 pages, 5x7½, illustated, $1.50.

Wendt—
Foundry Work
205 pages, 5x9½, illustrated, $2.00.

McCaslin—
Wood Pattern-Making
290 pages, 5x7½, illustrated, $2.25.

Send for copies of these books on approval

McGraw-Hill Book Co.

Penn Terminal Building

370 SEVENTH AVENUE NEW YORK

TECHNOLOGY

*T
61
S63

Thirty-second Annual Meeting of the Society for the Promotion of Engineering Education University of Colorado Boulder, Colo. July, 1923

ENGINEERING EDUCATION

Bulletin of the

Society for the Promotion of Engineering Education

TJ1
E6

Published under the supervision of the Publication Committee:
Chas. F. Scott, Mortimer E. Cooley, F. L. Bishop, *Editor*.

The following, Chairmen of committees, are by action of the Council Co-operating editors.

JOHN AIREY,	W. S. FRANKLIN,	R. S. KIRBY,
R. M. BIRD,	E. R. HEDRICK,	W. T. MAGRUDER,
A. H. BLANCHARD,	C. S. HOWE,	J. R. NELSON,
H. E. DYCHE,	H. J. HUGHES,	L. L. THURSTONE,
J. T. FAIG,	D. C. JACKSON,	P. F. WALKER,
O. J. FERGUSON,	D. S. KIMBALL,	W. E. WICKENDEN.

VOL. XIV LANCASTER, PA., SEPTEMBER, 1923. No. 1

TABLE OF CONTENTS.

Foreword—Engineering Education. P. F. Walker, President 2
Presidential Address. Charles F. Scott 6
The Engineer as a Leader in Business. W. E. Wickenden 15
Leadership of Teachers. Ira N. Hollis 32
Minutes of the Council Meetings at Cornell University 46
Minutes of the Regular Sessions of the thirty-first annual meeting 51

ENGINEERING EDUCATION.

FOREWORD BY THE PRESIDENT

P. F. WALKER,

Dean, School of Engineering, University of Kansas.

Engineering education in the schools of this country is bound to be what the readers of this magazine make it. Much will be gained from contacts and conferences with contributing agencies, industrial and other, but in the last analysis those of us who are directly engaged in educational work must determine the trend of progress and the application of new ideas. The responsibility and opportunity both are ours.

The Cornell meeting has passed into history as one of the best that the Society has ever held. Numbers, enthusiasm, attractive surroundings, royal entertainment, and, above all, a distinct objective,—all combined to make it a notable conference. It has served its purpose of starting serious men to thinking anew on a serious subject: not a new subject, but one now being viewed at an angle slightly different. Now the task before us is that of carrying on. It is up to us to demonstrate our capacity for correct analysis of conditions, and our courage in basing action on facts in accordance with our own teaching.

The new president has one text on an occasion like this. It is the doctrine of full discussion and united action. A few men cannot accomplish the purposes of the Society. There must needs be action by all, the interested coöperation of all, the constructive thinking of all. The feeling is abroad that changes of some nature in the educational program are impending. The Society has undertaken the task of making a real study of conditions so that a basis may be established for any possible modification. But the responsibility for changes in the program of any institution lies with the faculty of that

179744

institution, which, in the composite, means that it lies with the membership in this organization. It is only through discussion and joint action that results will become effective. In making this statement it is not alone the new enterprise committed to the Board of Investigation and Coördination that is in mind. There are other avenues through which the Society functions, and other matters of importance which demand the earnest consideration of all. The new officers are committed to the policy of bringing individual members into direct participation in Society activities.

The two agencies which are ready at hand for the accomplishment of this are the regular committees and the sections and branches. The first is to be dealt with through direct correspondence with members involved. It is to be regretted that larger numbers cannot be employed in the committee work. The second will be discussed further at this point.

The development of local sections and branches is a distinctive thing in all engineering organizations today. More and more it is being realized that the contact of the individual with large national organizations is lacking unless there is a definitely established medium committed to the consideration of questions with which the member has a personal interest. It is said that confession is good for the soul, and hence I confess that when the proposal was made for the formation of a section in my region I was inclined to be lukewarm. Within the three years this particular group has been developing, however, the benefits which it has brought to the teaching staffs of the institutions presented have been so obvious that I have become an ardent advocate for the movement. Whereas at an annual meeting, unless it be held at some nearby point, a delegation of 5 or 6 members from one institution may be considered a very creditable showing, at regional section meetings delegations of three times that size are common, while at an institution where the meetings are held in rapid rotation every member presumably is on hand. This is said, having in mind the section which includes several institutions.

In the prosecution of ordinary school work, faculty meetings are very likely to be filled with business matters which have to be put through with dispatch. Meetings are usually held, as a matter of duty, at hours of the day when other phases of school work crowd upon the mind and conditions are not such as to induce an adequate consideration of questions which form the basis of the teaching profession. Much is to be gained if the members of local groups meet occasionally, away from the atmosphere of routine work and in surroundings where comfort and social pleasure may not be lacking, to talk over matters and questions with one another, as to why they are teaching, what they are teaching, the reasons why they are teaching such subjects, what the aims of the students who are being taught may be, and any other matters pertinent to the occasion. This is the feature of the local branch where membership is limited to those who are associated together in a single institution. It is a thing eminently worth while for the individual group that may happen to be a part of a larger section.

The distinctive thing about engineering education is that we are dealing with live and growing matters. Engineering practice is changing and the demands upon the engineering graduates have a tendency to change in corresponding degree. Probably this is not so likely to affect the demands made upon the graduates in technical lines, as it is to typify the growing idea that the engineer must be a man of affairs, ready to deal with many of the problems of modern society. More and more it is being felt that economic and social progress depends upon the development of conditions which have a technical basis. It is not my purpose to define this tendency, but simply to call attention to the fact that it is a real thing to which engineering educators must need give attention.

May we not in this year which lies before us, devote our energies to the development of our groups in order to furnish opportunity for discussion on all such questions? It is not that we are at a point of impending revolution, but simply that we may better formulate ideas with reference to the true

problems which we are facing. One of the functions of S. P. E. E. is to benefit the individual teacher by making it possible for him both individually and collectively to perform his proper function. At the same time that we develop the group wherein each individual meets his local problems, opportunity will be presented to familiarize all with the progress of the work which has been intrusted to the Board of Investigation and Coördination. It may be a year of substantial progress if we will to make it so.

TRAINING FOR LEADERSHIP.

PRESIDENTIAL ADDRESS.

CHARLES F. SCOTT.

In planning the program for this Convention our Secretary has assigned a common topic to many speakers. It happens that the present address is the seventh dissertation on Training for Leadership. It is quite unnecessary to repeat all the good things that have been said, and it would be discourteous not to leave something unsaid for those who are to follow. But fortunately the subject is big enough for us all.

And just what is our problem? Assume before us a group of freshmen, young fellows from high and preparatory schools coming to Cornell. They come with various plans or some may not know just why they are here, but we are commissioned to train them to become leaders. We have not defined just what a leader is. The word suggests some ideal greatness; maybe we think of Washington or Napoleon, or Westinghouse or Hoover, and our function is to transform our freshmen into leaders.

I had a very interesting educational evening a year or so ago; I happened to be in East Pittsburgh when the Westinghouse Technical Night School teachers came together for a teachers' conference. Of the thirty or forty present a dozen or more told how they did this and why they did that or discussed the vital problems of their school where a thousand boys and girls who worked by day studied at night. One of the topics was "What shall we do to create interest in our pupils?" "Create interest?" was the reply, "we don't need to create it, it is already there, that is why the boy came to school and what we must do is try not to kill it but to keep it alive."

Likewise with leadership; the first requisite in training for

leadership is not to repress and kill the inherent leadership which many boys already possess. The tendency is toward mass production in education; we deal with groups; leadership is individual; the leader separates from the group and is distinctive. Extra curriculum activities, devised by the students themselves, give opportunity for leadership and are a training school for leaders. Our problem, then, is to afford opportunity for initiative and individuality and to find the methods by which the natural tendency for leadership may be the means of getting results in the curriculum as well as outside of it.

But why the call for leaders and why is training for leadership specially urged upon the engineering teacher? It is because of a new and fundamental condition in our modern civilization which is largely the outgrowth of what the engineer has been doing—it is an effect of science and engineering. Engineering is a method by which science is applied for the general benefit of man. Science and its application to useful purposes through engineering have brought about the use of power and of machinery and modern transportation and communication, and all these have tended away from individual activities into group activities. And groups need leaders.

This is all so familiar to a group of engineers that it scarcely needs elaboration or illustration. A generation or two ago the factory was the small shop. In the great life with which I have been privileged to come in contact, that of George Westinghouse, the beginning was in his father's little machine shop where agricultural machinery was made. After a time George with his inventive ability and organizing ability had a factory of his own and then another and then another. At the end of his life he had built up many industries scattered over many states and many countries.

Power and machinery, transportation and communication enabled him to develop and coördinate vast enterprises with the facility with which his father could conduct one little shop. The change from the little shop, owned and operated by one man, to our great national industries in which stock-

holders and directors and a great organization are essential parts has come about in a single lifetime and George Westinghouse was the last of those outstanding men who had built up a great industry, was the last to be at the head of the great industry he had created. Carnegie had retired, Krupp had retired, and other leaders had gone. Thus we see the change from the old to the new industrial condition. Manufacturing, transportation, business corporations are all on the new and larger scale. We are divided into various special lines of activity and interdependent groups each performs by its own part in the complex organization which operates our modern civilization. And this new method calls for leaders, for those who can plan and organize and direct, for those who will lead where others follow.

All these things have made, as we all know, a wonderful change in our whole method of living. We are familiar with the startling statistics showing these great changes; the changes that we ourselves have seen have exceeded those of previous centuries. Some two weeks ago I attended the Convention of the Electric Light Association. It was stated that the income of electric power companies had doubled in the last five or six years and had reached the enormous total of a billion dollars a year; nevertheless the increasing demand for power would call for an additional imbursement of $15,000,000,000 during the next ten years. There was also an engineering presentation of a super power system for the whole country. A map showed a national network of electric circuits for distributing all over the country the energy from its various sources of fuel and water power, just as the network of railroads collects and distributes the materials from natural resources and factories. In another electrical field the advance is no less remarkable. The telephone directory of New York City with its million subscribers, is as big as a dictionary but it is anticipated that the number will be doubled in a decade. And electric power and communication are the means of production and activity in industry and business.

We haven't reached the end. We are rather at the begin-

ning of a larger expansion of the things with which engineers have to do and which render service to the community.

And why is the engineer concerned with leadership? Dean Kimball has given some excellent reasons why the engineer has been called to leadership in industry. It is because they couldn't get along without him, because in the newer type of production in the factory the engineer needed to be in the factory in a new way to direct and advise. In a larger sense Dean Kimball showed that the problems of the present are problems of a new kind without precedent. The lawyer goes back for precedent. The further back he can go, the more sure he feels, but the new conditions which the new engineering era has produced have no precedent; they bring problems which the legal mind is not adapted to solve; which the business mind in its concern with immediate achievement and expediency cannot solve, which calls for the scientific or engineering mind that is ready for problems of a new sort which never have been met before.

And the leadership that we are considering is leadership in what? Much that we have heard today implies that it is leadership in administration, in management, in human adjustment. But we must not forget that distinctly we are scientific, we are applying science in the control of the matter and forces of nature for the benefit of mankind, we must supply the technical ability for operating the larger industries and the larger enterprises, upon which we are getting to be more and more dependent as the magnitude and complexity of our transportation and industries increase.

How shall we reconcile the training of technical experts and of leaders in administration? Do we not confuse engineering education and the technical engineering profession? Our engineering education prepares men for many professions, just as does a classical education. Its training in scientific method, in fact-finding, in logical analysis and deduction in quantitative thinking is suitable preparation for dealing with affairs in many fields aside from the strictly technical. Once the prevalent ideal was the preparation of engineering

students to become technical experts. Recently the tendency is to broaden engineering courses by adding general subjects and reducing the technical to a training in fundamentals. Specialization may follow, in the graduate school or in the industries. Just as the work of the engineer through transportation and industry has had a transforming influence upon modern life in our commercial and social and national relations, so also must men with engineering training enter into many fields of activity which the new conditions have created.

In this training there must be a basis of straight thinking, of making the man a capable engineering machine for solving problems of whatever kind. Students should appreciate what science and engineering have had to do in making the world what it is today and they should be exposed to a vision of the opportunity and responsibility which the future holds in store. Some will respond to the vision and will devote their best efforts to meet their opportunities. Some will attain to minor leadership, some to greater, and some possibly to the largest leadership in national or world affairs.

Some two years and a half ago Mr. Hoover was chosen president of Federated American Engineering Societies, that new group of engineering societies which stands for something beyond the technical in engineering, which proposed to represent the engineer in public service. Mr. Hoover in his first address spoke of the wonderful changes that had come about in our standard of living through the activity of the engineer but at the same time he said there have come evils and ill-adjustments, which are liable, if not corrected, to break down and destroy the value of the excellent things. In our modern industrial life there are intermittency of employment with seasons of overemployment and underemployment, ill-distribution of wealth which leaves many suffering while others are indulging in luxury and there is inefficiency and waste. He said that in our modern life we were segragating into industrial and social groups and that each group tends toward its own individual advancement. He pointed out the engineering

group as the one best fitted in many ways to deal with the problems of readjustment.

Mr. Hoover had great confidence in what the engineer might do. A few months later while the secretary of the Federation was waiting in an anteroom to see him a caller interviewed his secretary. The secretary replied that Mr. Hoover wouldn't take up a new project as he was not interested in anything just then except the famine fund and the engineers. A little later in Syracuse at a meeting of American Engineering Council, Mr. Hoover remarked to several of us that it seemed to him the most important thing for him to do as soon as he got through with the famine matter was to take a month or two in a trip over the country to get the engineers interested in Federated American Engineering Societies. That very evening came the announcement of his appointment to the cabinet. As a member of the cabinet he is now realizing what in my view is the outstanding conception of the engineer as a leader. He is putting under the commerce of this country a foundation for the future. He is making the Department of Commerce the fact-finding department of the government which will give a basis for the operation of the industries of the country on engineering principles.

Some six months after he went into the cabinet he addressed informally the Engineers' Club of New York. He said that the engineering mind gets quite a jolt in Washington because the way of doing things is so different. He said most discussions are without regard to facts. Take the railroads of the country, a matter of infinite importance and universal discussion, but he said you can't find five men in the whole country who can agree upon the facts in regard to the railroads. If we had the facts to begin with he estimated that 85 per cent. of the discussions in congress and by the public could be dispensed with.

The criticism is sometimes made that Mr. Hoover is not a success because he isn't enough of a politician. I wonder if we couldn't say of thousands of men in Washington that they are not a success because they are too much of a politician

and not enough of an engineer. If we had a thousand Hoovers or a thousand men with the engineering training and inspiration of Herbert Hoover in Washington, this government would be a very different one.

In his baccalaureate at Yale last Sunday President Angell dealt with matters which concern the larger purposes of this Society. The newspaper headlines the following day read: "Neither science nor humanism can save the World." The following sentences indicate the trend of the address.

"A great force has grown up in the world in the last century or two which was practically unknown to earlier history, a force with which we must have to deal, a force which is moulding our entire civilization. This force is modern science with its amazing technique and its utterly unlimited possibilities. The commanding position which Germany had won before the war was due to the work of her scientists, who had made her industry and her commerce more efficient than that of her rivals; and but for the grotesque political blunders of her rulers she would today be firmly entrenched in a position of international prestige. In all that concerns the physical side of life, and in much that affects its social fabric, modern science is entering to give new power, creating and supplying new demands and bringing to those nations that cultivate it new control over life, over nature and so over all the peoples of the earth.

"There are many who see in this menace of a purely materialistic epoch with wealth and luxury and mere physical comfort the wine of life and the standard of success. They look askance upon science and technical education as the corrupting source whence spring many of the evils they allege and dread. Against these dangers they urge the promotion of humanism, of classicism, of literature and art.

"It is true that science as such is impersonal and non-moral. Science is devil or angel, depending wholly upon the uses to which her achievements are put. But it is quite as true that the great nations which gave birth to those superlative works of the human spirit fell into decay. Humanism may be so conceived and cultivated as simply to offer a refined form of self indulgence, a type of intellectual luxury.

"No, what is needed in season and out if the national tone is to be kept high and pure is devoted character, high moral purpose, essentially religious conviction."

Our Society, realizing the changes that are coming and that the future has something different in store, and as industry is awakening to its new needs for technical and administrative leadership of a higher order, is setting about to make a new study of the situation to ascertain how best we can prepare men to meet the coming conditions. In this study we should heed President Angell's conclusion that only by the awakening of the soul of the individual man to a sense of moral purpose and a deep rooted moral and religious conviction can the real solution of the problems of nations and of the world that are facing us today be safely and sanely reached.

If in a large way we look at what has taken place in the past; if we look at the last decade with the war which turned the work of the engineer into an instrument of destruction which has left the world in greater turmoil than it has ever been before, we of this generation realize that we have made a sad mess of it. And we are turning over to the next generation problems such as never before confronted the world. Whether it solves these difficulties will depend on the young men of today, upon the college students of today. To them it is a challenge, an opportunity such as never occurred before. And it is our duty and privilege to do our part in preparing these students for that future.

A few days ago I greeted the electrical members of a reunion class. One who had been an outstanding student told me of his present surroundings. I knew his career since graduation in connection with several power companies and in war service. A year or so ago he wrote me his intentions of leaving a large company in an Eastern city where advancement to a leading position seemed assured. He planned taking charge of a small company in a small town. I wrote that I was disappointed that he had made what seemed to me a great mistake. He replied that he disliked the restrictions of a large organization and a large city and wanted to develop in a freer atmosphere. And in our recent talk he said he was enjoying the new life in which he was interested in managing

a company, in personally counselling his employees and taking his part as a citizen of the town in civic and church affairs. And I realized that this capable, high-minded fellow was truly a leader. While we need the great leader we need also leadership all through the whole realm of society. If the graduates of our engineering schools go forth with sound training, large vision, high ideals and the spirit of true service they may become leaders in whatever place their lot may fall, and may make engineering leadership a new factor in democracy.

We have been for several days viewing the realization of the vision of some sixty years ago of Ezra Cornell. We have seen different phases of that vision portrayed. He wanted to make a school of a new kind where any person could learn anything. In its physical beginning there is an item of interest. It was suggested that the first building should be placed half way up on the hillside just beyond the village but he said, "No, let's go up on the heights; we want room for expansion, for some day we may have six hundred students."

We are now building for the future. Let us go up on the heights and begin a new structure adequate to meet our largest vision of what the engineer of the future should be. And happy will we be if too there is room and we have begun to build by a plan which will accommodate a structure tenfold greater than our vision now can see, for in less than a life time the size of Cornell is tenfold more than the greatest vision that the seer Cornell could see.

THE ENGINEER AS A LEADER OF BUSINESS.

BY W. E. WICKENDEN,

Assistant Vice-President, American Telephone and Telegraph Company.

The fact that leadership in industry and in business have separate places on this program suggests that these twin words, industry and business, which can sometimes be scarcely told apart, are here understood in their narrower sense. Industry, I take it, denotes the productive organization of society and business its distributive and commercial organization.

The word engineer also comes in for a wide variety of usage. A decade or two ago there was little danger of confusing the engineer, the economist and the psychologist. The three were in separate camps, each with an undisputed title to his own ground, with a considerable area of unclaimed territory between which no one seemed to covet. This no-man's land was the field of business and industrial administration, which all three parties are now striving to annex. Having become an inhabitant of this disputed region, I feel bound to maintain a strict neutrality. Some engineers have been quite busy rewriting the charter of their profession, to make it cover explicitly the control of human activity as well as the materials and forces of nature. A neutral party may not go so far, yet he may, by implication, leave large areas open to occupation. I shall limit my use of the term "engineer" to denote a person who is highly skilled in the control of the materials and energy of nature and in their adaptation to social and economic ends.

We are often reminded that engineering colleges give an engineering training, but do not produce engineers. That is, there is a difference between the engineering graduate and the engineer, which is a matter of several years of experience

of quite a definite type. If large groups of engineering graduates enter directly upon the sale of life insurance we are not thereby justified in discussing the engineer as a life-insurance agent. In my later remarks, I shall endeavor to differentiate quite definitely between the engineer and the engineering graduate.

This subject is like Mark Twain's statement about the weather, that it is strange that while everyone talks so much about it, nothing is ever done about it. I have felt that you would be much more interested in some results of a study of the leadership of a large business organization than in a purely general discussion of the subject. In the Bell telephone system we have been endeavoring to map out a program for the recruiting and development of technical and supervisory personnel which will go along with the programs of finance, engineering, purchasing, manufacturing, construction and operation which have been mapped out for a considerable future period. The detail studies of our past experience and present situation have brought out some interesting facts which have a bearing on my subject.

The Bell System comprises three general types of organization, viz. (1), the operating companies which are engaged in rendering a commercial telephone service; (2), the affiliated company for the creation, purchasing and supply of physical equipment; and (3), a general staff engaged in administrative and financial activities and in consulting services of a technical and legal nature. The operating companies and the general staff collectively constitute a fairly typical business organization, while the supply company constitutes a typical industrial organization. The latter organization has not been included in any of the studies referred to in what follows.

Figure 1 shows the results of a study in which the principal supervisory and technical officers of a representative group of operating companies are grouped according to responsibility and classified according to type of service. Group A includes the general executive and heads of the

functional departments. The preponderance of administrative work may be noted. This is perhaps made more apparent

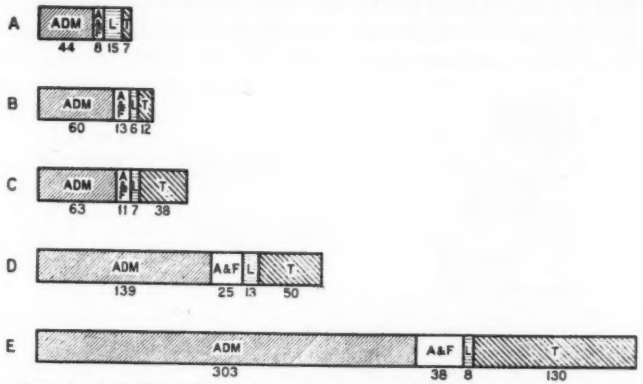


FIG. 1. Principal Executive and Supervisory Positions, Six Representative Telephone Companies, Classified by Grades of Responsibility. Numerical Division by Form of Service. Adm, administrative; A & F, accounts and finance; L, legal; T, technical.

in *Figure 2* which shows the same groups divided by percentages, instead of numerically. It is clear that legal

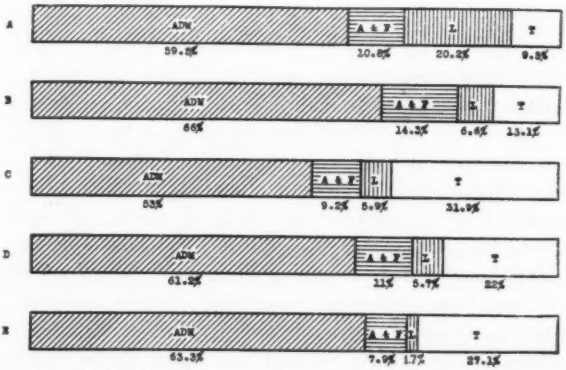


FIG. 2. Principal Executive and Supervisory Positions, Six Representative Telephone Companies, Classified by Grades of Responsibility. Percentage Division by Form of Service.

officers come in for increased recognition in the higher ranks, and that the reverse is true of technical officers. The latter fact is compensated for by the large number of administrative positions to which men of technical training and experience may rightfully aspire.

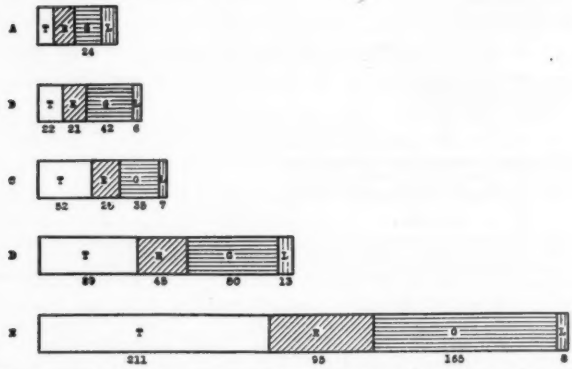


FIG. 3. Principal Executive and Supervisory Positions, Six Representative Telephone Companies, Classified by Grades of Responsibility. Numerical Division by Educational Preparation Preferred. T, technical; E, either technical or general; G, either general or business; L, legal.

To bring these relations out more clearly the same groups were analyzed with respect to the form of educational preparation best adapted to each position. It was possible to classify some positions quite definitely, while past experience led us to recognize an option in respect to others. *Figure 3* shows the numerical groupings and *figure 4* the same groupings converted to a percentage basis. Now it is clear from this that the engineering graduate comes into competition with the non-engineering graduate in a considerable area. The work here consists chiefly of the supervision of operations which have a technological foundation, but in which success depends principally upon selecting, training, organizing and directing people, measuring and developing their proficiency, maintaining standards, promoting morale and meeting emergencies with prompt resourcefulness. In such work technical

training does not enable a second-rate man to win out over an abler man with good general education. Since there is no surplus of first-class engineering graduates available, the present tendency is to reserve these for positions which put a considerable premium on technical education. In recruiting for the optional positions there is a marked tendency to pass up

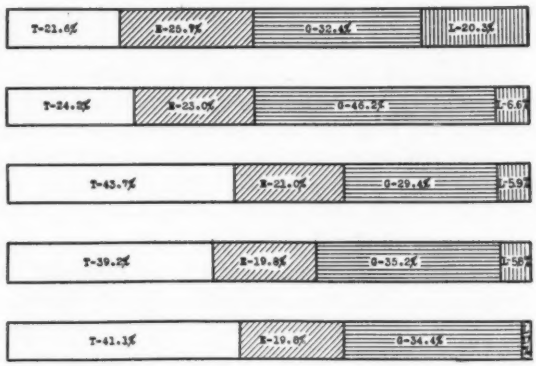


FIG. 4. Principal Executive and Supervisory Positions, Six Representative Telephone Companies, Classified by Grades of Responsibility. Percentage Division by Educational Preparation Preferred. T, technical; E, optional—technical or arts and sciences; G, optional—business or arts and sciences; L, legal.

the second and third rate technical graduate, who is characteristically weak on the personal side, and to select a superior type of man from the arts colleges.

A group of organizations with 250,000 employees, a majority of whom are men in early maturity, has within itself a vast reservoir of man power. The extreme decentralization of telephone operations calls for a self-supervising type of male personnel quite different from that found in many industrial plants. The demands made on loyality in the interest of public service and on resourcefulness in meeting emergencies tend to bring forth from the ranks a particularly promising type of non-college man. It was inevitable that we should

look into our history to see how far we could depend upon our general ranks to supply leadership and in what divisions of our work most could be expected from this source. An additional motive for this inquiry lay in the unprecedented expansion of the business and the necessity of bringing up to responsibility as quickly as possible a large addition to the supervisory forces.

Figure 5 illustrates a method of analysis found to be very helpful in this connection. Our personnel records did not afford an unlimited amount of information. It was possible in every case to determine a man's salary, his period of service in the Bell System, and whether he is a college graduate, a non-graduate college man or a non-college man. Unfortunately for present purposes it was not possible to clearly differentiate college graduates into engineering and non-engineering groups in this detail of the work. It is quite certain that a majority of those indicated as graduates hold engineering degrees and that their distribution is very similar to that of the entire group of graduates. *Figure 5* is fairly typical of those companies which until quite recently gave little systematic attention to employing college men. Whatever characteristic differences appear in the distribution of college and non-college men may be ascribed to natural selection.

The individuals are classified by code and spotted with respect to salary and service records. In place of the specific salary scale used in our actual studies the chart is here divided on its left axis into senior, intermediate "a," "b," and "c" and junior grades. These grades are referred to in subsequent charts. Three diagonal lines are observed. After a comprehensive analysis of the data these lines were drawn to mark the boundaries between areas of exceptional, rapid, ordinary and slow progress in salary during the first twenty years of service. Differences in size and economic environment of organizations in different sections of the country made it desirable to employ three distinct sets of progress scales.

Figure 6 has been chosen to represent a somewhat larger company which has long made systematic effort to select

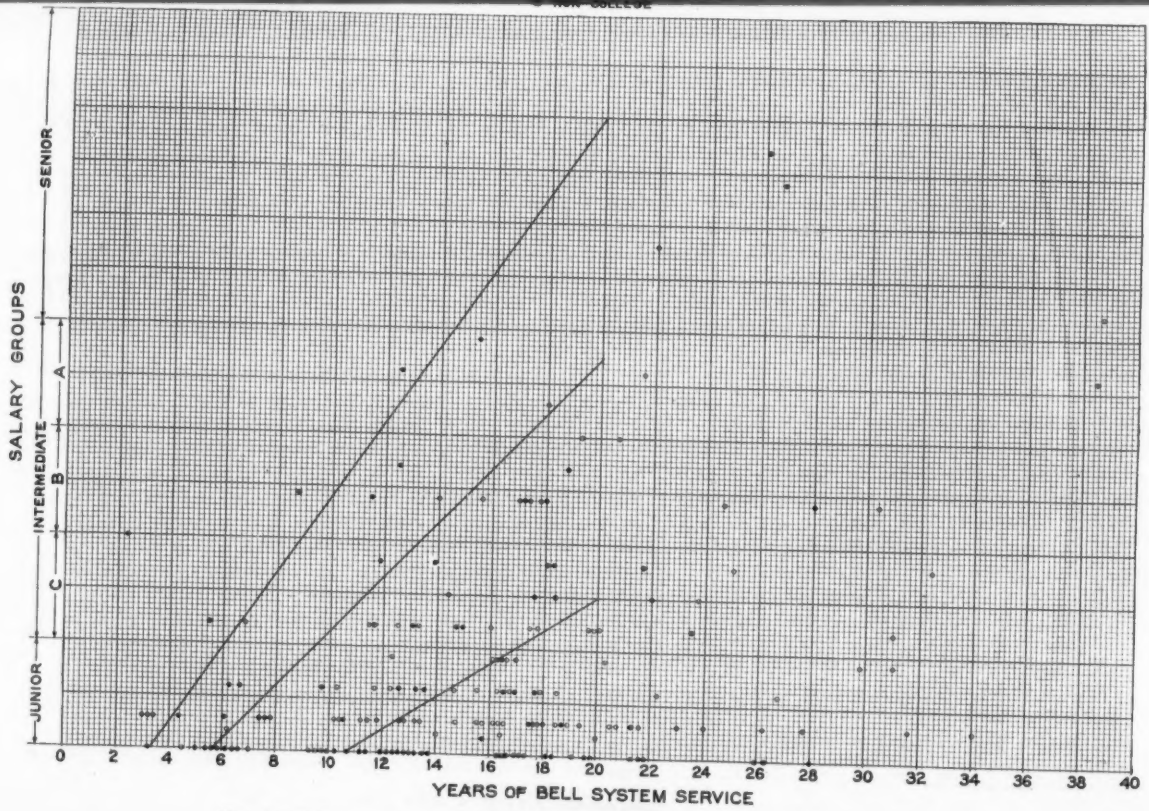
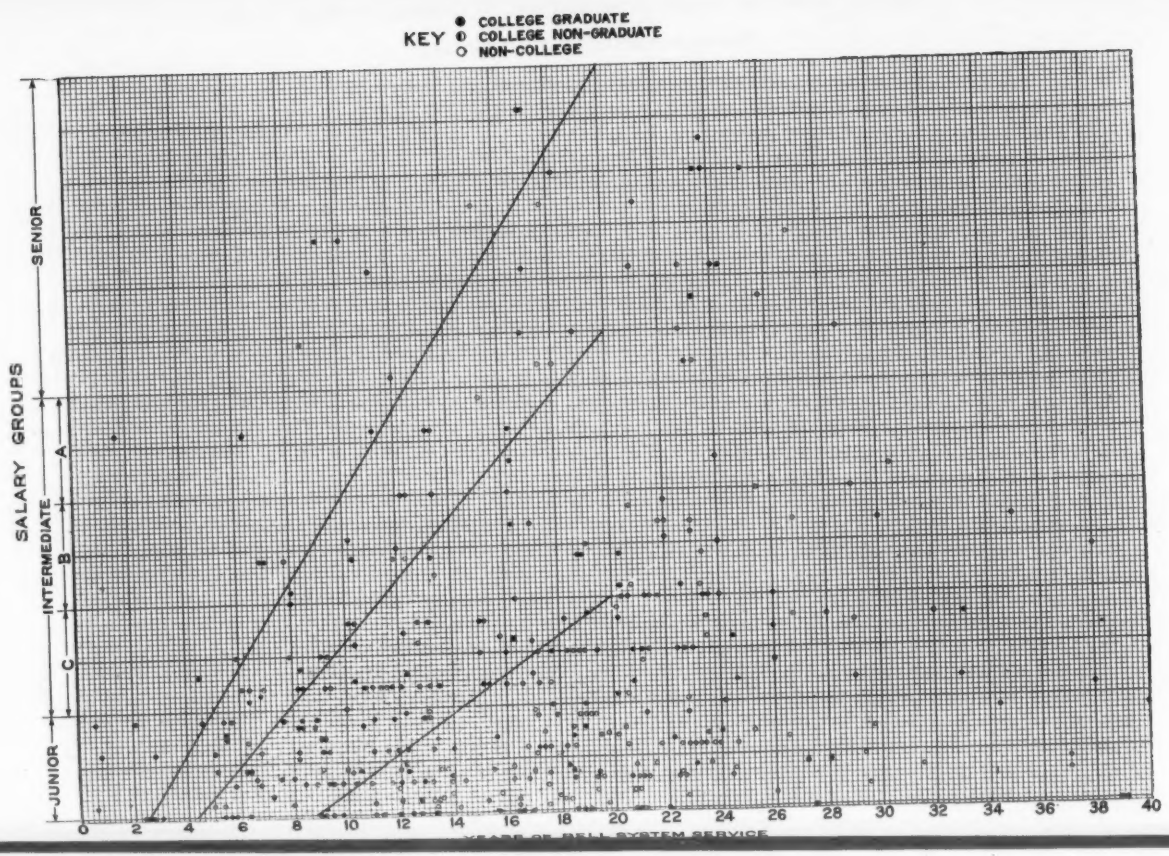


FIG. 5. Telephone Company Y. Distribution of Salaries and Service Periods.


KEY
● COLLEGE GRADUATE
◐ COLLEGE NON-GRADUATE
○ NON-COLLEGE
SALARY GROUPS
SENIOR
INTERMEDIATE
A
B
C
JUNIOR
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
YEARS OF BELL SYSTEM SERVICE

and employ college men in accordance with rather high standards. The progress of graduates and their preponderance in the higher ranks show up conspicuously. This chart brings out rather strikingly the adaptability of the selected college graduate for rapid development in a period of expansion.

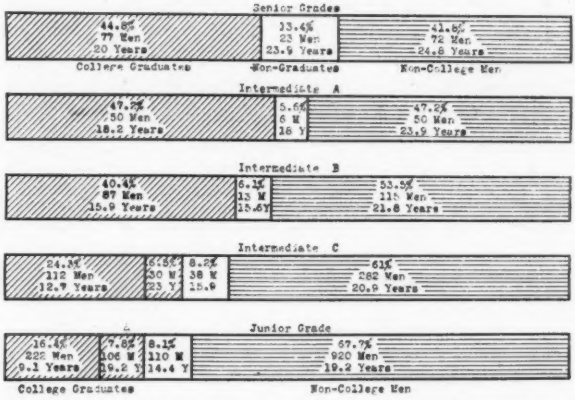


FIG. 7. Principal Supervisory and Technical Officers of Six Telephone Companies, Grouped According to Grades of Responsibility. Note: Areas correspond to percentages.

In *Figure 7.* we have the composite results of the analyses of six companies of varying size and location which have so far been completed. I scarcely need call your attentoin to the increase in the proportion of college men with the rising scale of responsibility. The number of non-graduates who have gone far is rather striking, as are the small differences between the service records of the graduates and non-graduates. The latter fact makes one wonder whether a college is significant primarily as a training agency or as a selecting agency.

The chart brings out rather forcefully the time which can be saved by developing properly selected college men for positions of responsibility. It was evident from the original

charts that the two lower groups contained a considerable sprinkling of graduates who had stagnated and whose progress had not been more favorable than that of men who had climbed to these ranks from the very bottom of the ladder. An attempt was made to segregate these men from the really progressive element in the two lower groups as is evident in the two areas for graduates. Considering the fact that only two of the six companies have had consistent programs of selection and recruiting for any considerable period, these results are believed to be a very substantial vindication of the college men in general and the engineering graduate in particular.

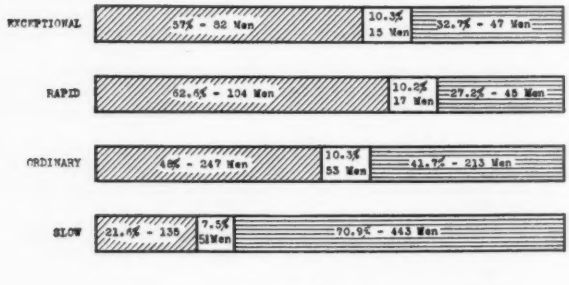


FIG. 8. Principal Supervisory and Technical Officers of Six Telephone Companies, Grouped According to Advancement, Relative to Period of Service. Note: Areas correspond to percentages. 89% of college graduates exceed average progress rate of non-college men. 11% of non-college men exceed average progress rate of college graduates.

Figure 8 reviews the composite records of the same six companies by progress rates, rather than by grades of responsibility. The result is strikingly favorable to the college men. It should be brought out in this connection that college men are in no sense marked as such after their introduction to these organizations and that the terms of competition be-

tween college and non-college men are as fair and even as we know how to make them.

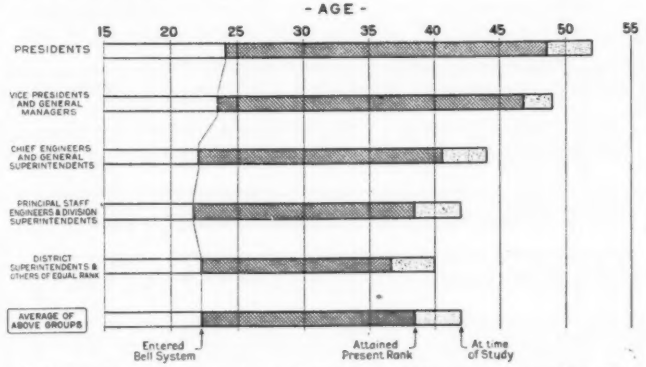


FIG. 9. Average Chronology of Principal Officers of Operating Telephone Companies. In general the college men in these groups have service records in the Bell System from four to six years shorter than the non-college men.

Figure 9 is a study in the chronology of officers of operating companies. Considering the average periods of experience here shown as necesary to develop officers of these grades the more rapid progress of college men, especially in attaining the junior grades here shown is regarded as very significant in a period of expansion.

Figure 10 sets forth in tabular form significant facts from the educational histories of the entire group of principal officers of the general staff and the operating companies. These groups do not go down to the same levels as most of the earlier charts. In fact they include only the A and B groups of the first charts shown and very few below the senior groups in the more recent charts. The general headquarters staff shows a considerable preponderance of college graduates, especially engineering graduates. This is due to the fact that the two largest departments are concerned with consulting services in the fields of research, development, operating practices and engineering, and have long been strongholds of

	Rank.	Numbers.					Percentages.			
		Eng. Grad.	Other Grad.	Non-Grad.	Non-College	Total	Eng. Grad.	Other Grad.	Non-Grad.	Non-College
Headquarters	General Executives	2	7	1	2	12	17	58	8	17
	Principal Staff Officers	10	8		2	20	50	40		10
	Accounting, Finan. and Statis. Staff	1	7		10	18	6	39	0	55
	Staff Attorneys	2	3	1	0	6	33	50	17	
	Staff Engineers	20	3	4	6	33	61	9	12	18
	Executive Assistants	2	3	2	0	7	29	43	29	
	Totals	37	31	8	20	96	39	32	8	21
Operating Organizations	Presidents	1	6	2	6	15	7	40	13	30
	Operating Vice-Presidents and General Managers	3	4		7	14	21	29		50
	Other Vice-Presidents	1	8	5	6	20	5	40	25	30
	General Auditors	1	1	1	13	16	6	6	6	81
	General Counsels (Exc. V. P's.)		5			5		100		
	Chief Engineers	12			3	15	80			20
	General Commercial Sup'ts	6	1	4	5	16	38	6	25	31
	General Plant Sup'ts	4	1	4	7	16	25	6	25	44
	General Traffic Sup'ts	4	5	3	4	16	25	31	19	25
	Exec. Ass'ts., Sec'ys., Treas., etc.	3	18	18	75	114	3	16	16	66
	Division Sup'ts. and Equiv. Line Officers	29	25	44	129	227	13	11	19	56
	Staff Accountants	3	12	11	64	90	3	13	12	71
	Staff Attorneys		31	4	7	42		74	10	16
	Staff Engineers	70	9	25	40	144	49	6	17	28
	Staff Supervisors	18	17	19	75	129	14	13	15	58
	Totals	155	143	140	441	879	18	16	16	50

Fig. 10. Educational Records of the Principal Officers of the Headquarters Staff and Operating Companies of the Bell Telephone System.

college men. The operating companies, on the other hand, have drawn heavily on their general ranks, especially for operating officials.

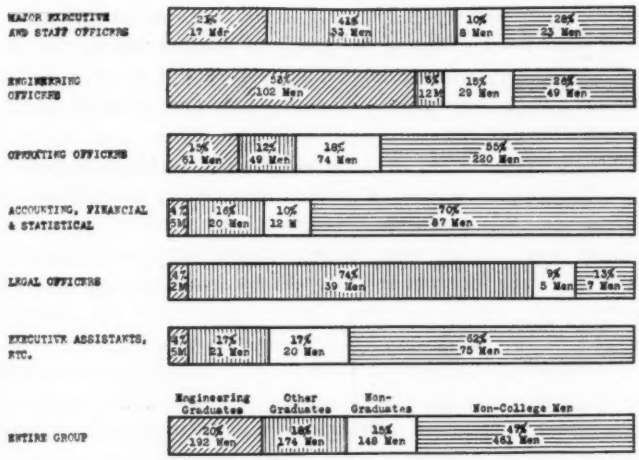


FIG. 11. Numerical and Percentage Division of Principal Groups of Officers according to Educational Records. Areas represent percentages.

In *Figure 11* these officers have been regrouped without regard to organization. From this it is evident that engineering graduates though in a clear majority among the graduates have not attained a preponderance in positions of major executive responsibility. Their great stronghold appears to be as engineering officers and as officers in charge of operations of a technological nature. It is not too much to say that the preëminence which the telephone art has attained in America stands largely to the credit of graduates of American engineering colleges. Any such acknowledgment must be broad to include the large group of engineers and research men in the staff of the Western Electric Company.

The share taken by engineers in the business management of the telephone system has been considerable. In particular

FIG. 10. Educational Records of the Principal Officers of the Headquarters Staff and Operating Staff of the Bell Telephone System.

the rate systems and the technique of commercial surveys and fundamental plan development have been largely the work of engineers. Despite the technical nature of the business and the freedom from dominance by marketing problems it can not be said that engineers have stood out as business leaders. The most notable exception is the group of engineering graduates among the general commercial managers, but there is little evidence that these men in their earlier days actually functioned as engineers.

Years ago in the rough and ready days of the business one of the officials—not himself a college man—had faith enough in sound scientific training to employ and train a group of college men. They were known to the gang as "Carty's dudes." I believe the records which have been shown here have amply vindicated Gen. Carty's faith and the pioneer virtues of his dudes.

To return to the general aspects of the subject, there seems to be little difference of opinion on the place of the engineer as a leader of industry. The place is his by rights and he can fail to hold it only by neglect of the broader aspects of his calling. The place of the engineer as a leader of business does not seem equally assured. Modern business is many-sided. It overlaps the productive processes of industry and includes them when the term is used in its broadest sense. The term business also includes the problem of finance, of marketing, of risk-bearing, of personnel and of legal relations.

We recognize readily two broad divisions of business, one in which policy is dominated by the production of goods and services, and another in which policy is dominated by marketing considerations. Public utilities fall in the first group, and the motor car business well illustrates the second. The former group seems to me to be a much more promising field of business leadership for the engineer than the latter, and even in the former he suffers certain handicaps arising from the defects which are inherent in his very virtues as an engineer.

THE ENGINEER AS A LEADER IN BUSINESS.

While much has been written about the psychology of business leadership, the subject remains quite vague. Less has been written on the psychology of engineers, but it is safe to assume that this group has a pretty definite conception of what is meant by the engineering habit of mind and work. There appears to be much in common between the business mind and the engineering mind. Both need to think logically, critically, objectively and with constructive imagination. The engineer leans more toward the quantitative, rigorous logic of mathematics and the business man more toward the qualitative judicial logic of the economic sciences. The critical powers and constructive imagination of the engineer turn naturally toward materials, structures and mechanisms, while the business mind orients itself toward courses of human behavior.

Leadership calls for more than the power to think. It certainly calls for the capacity to decide. Engineering decisions, except in unforseen emergencies, are based on mature deliberation involving a complete review of the evidence, a careful appraisal of all uncertainties and risks and provision of wide margins of safety. The engineer aims to be right every time. Ninety nine successful bridges do not eclipse the failure of one which collapses. Business decisions can not often be delayed until all possible evidence is in. Risks have to be taken without assured margins of safety. Business executives pride themselves on being right six times out of ten. Engineering decisions are apt to hinge on questions of cost or the behavior of material structures. Business decisions hinge on the probable course of human behavior. Engineering decisions rest largely on expert knowledge, while in business decisions much room must be left for shrewd intuitions.

Leadership calls for more than power to think and capacity to decide. It certainly calls for capacity to influence the action of other people so that decisions are carried out. It is my observation that engineers are distrustful of any other agency of influence and persuasion than pure, cold logic. En-

gineers as a group are inclined to be cool toward inspirational methods and relationships, and to persuasion on a basis of personality. Let me suggest this test—if you were a preacher how would you like to face an audience made up entirely of engineers every Sunday? This reliance on logic is one of the defects of an engineer's virtues. The fact is that men do not live by logic alone. In business relationships it appears to be particularly important to make one's associates and one's potential customers *want* to act in accordance with certain plans. Whatever their preëminence as logicians, engineers have not to my knowledge been very conspicuous as persuaders.

In view of the characteristic contrasts between the engineering habit of mind and work and that of the business executive, I believe we are not justified in predicting that the engineer will largely dominate business in the near future, especially those fields of business where questions of finance, risk-bearing and marketing outweigh questions of production. Nor do I believe that we would be justified in modifying engineering training so as to make it more commercial and less scientific in the expectation of rearing up a generation of business leaders. I seriously doubt whether by any shift of curriculum or method the colleges can produce leaders as a specific product.

I must confess to some amazement at the prevalence of the idea that by electing certain courses of study or submitting to certain teaching methods it is possible for a student to virtually predestine himself to an executive career. Perhaps we owe much of this to the advertising of commercialized institutes and corporations for extension training, but the idea has crept into formal college literature and has colored somewhat the catalog statements relating to curricula in business administration and even some engineering courses. This idea seems to me to involve a mistaken conception of what colleges can and can not do, as well as a false simplicity in the specifications for a business leader.

There are some things which colleges can do to a higher degree than any other institution. They can train men to think logically, to study effectively, to investigate with discrimination, to plan intelligently, to work systematically, to express themselves with clarity and vigor, to appreciate and enjoy things of beauty and to pass valid judgments on their own work and that of other men. There are some things which colleges can do to a less complete, but yet highly significant degree, such as training men to know other men's minds, to estimate human reactions, to coöperate with one's fellows, to strike a just balance between details and general relations, and to decide issues on the basis of evidence, even when it is not wholly conclusive. There are other services which colleges can render in degrees which vary widely with the individual's capacity for response, such as to stimulate the imagination, to clarify the ethical sense, to develop self-confidence and the willingness to assume the consequences of one's decisions, to recognize ability in others and to organize and delegate responsibility.

What are all these powers but the raw materials of leadership? True enough, but a leader is not a definite type of person with distinctive and characteristic qualifications. He is a complex of innumerable elements and exists in infinite variety. We cannot formulate his "qualities and characteristics in such a way as to make them a very definite part of a program for the systematic training of executives. And if we could, it may well be questioned whether it would be wise to do so; for the hope in the leaders of the future is not in their stereotyped perfection, but in their originality and resourcefulness." *

* Link, "Education and Industry," p. 157.

LEADERSHIP OF TEACHERS.

BY IRA N. HOLLIS,

President, Worcester Polytechnic Institute.

I regret very much that I was detained in New England during the first two days of this meeting. The discussion must must have been interesting and beneficial, because timely. The subject that has been put down for me is somewhat of a surprise, as I had written along a different line. I was thinking more about engineering as a learned profession, and I had asked myself the question "How far is it a learned profession comparable with law, medicine and the ministry?"

Many years ago I spent the evening with one of Boston's best citizens. He was then a member of the Corporation of the Massachusetts Institute of Technology. He said to me, "The Technology and other engineering schools are the places to educate young men for subordinate routine positions, the leaders being educated at the great universities." I asked myself at that time, "Is this true?" In general, men in the United States are not products of schools. They may be influenced and benefited by attending college, but their success is largely dependent upon what is born in them. They may learn leadership by experience with men and by some experience in athletic games before graduating from college, but they rarely learn it in the class room.

I sat at the Harvard Commencement a few days ago and heard several addresses that turned the world topsy-turvy. There were four dissertations by students. The first one was the usual Latin address delivered very much in the style of Cicero and dwelling on a subject that he probably never would have touched, because the boy two or three times called out, "O, puella," and that part of it I understood.

The third address was by a young man who spoke on the

subject of the classics and their value to American education. He said they would never be a success until we took the teaching of the classics out of the hands of the scholars. That was upsetting to our modern theory of education, and yet there is a large amount of truth in the idea that philological teaching is not one of the humanities, whether it be devoted to the classics or to modern language.

The last address would be interesting to this audience of engineering teachers. It was by a young engineer and it seemed to me unprecedented that a graduate in engineering should have the opportunity of speaking before a great audience of distinguished men and women on the subject of the engineer in the world service and at a Harvard Commencement. He said "There are four learned professions; they are the ministry, medicine, the law, and engineering; and without the last, the other three could not exist." And I must say that he made out a very good case. Of course we all know that food, clothing and shelter from the elements form the prime necessities for humanity. The other things enable men to live together in what we call society. A large amount of leadership is needed to effect the reconciliations that will make society possible.

It is very necessary then that young men and young women should learn something about the value of leadership. There is so much about the teaching of communism and the equal distribution of everything in this world that we need some sound doctrine on the elements that have tended to promote ship and no communism would suffice to produce satisfactory civilization. As a matter of fact, it has grown through leader- progress. It is a mistake to treat an equal share of property in this world as a true and successful kind of communism. The equality in opportunity to develop the maximum of one's abilities is a real communism that we are trying to establish in the United States, but it involves leadership by the ablest and routine work by those who are best able to do that kind of service to the public. The leaders great and small in this world have been the teachers of humanity, but it is difficult

to reverse this and to speak very convincingly on the teachers in the training for leadership. Have we not in general been confusing leaders with executives? Often they are one, but most generally the executives are not the leaders. They are simply carrying out orders, and it is this very fact that produces a certain confusion and vagueness of ideas.

The Naval Academy and West Point have often been called the training schools for leadership, but they are not that at all. They are the training schools of discipline for executive officers, who are simply in their positions to carry out orders. It is the rarest thing in the world that an officer in either service is called upon for any great amount of leadership. That does not mean that some do not develop a natural capacity that sets them in a different classification from their companions. One of the best examples of that is found in Leonard Wood, who is a great leader of men and has, therefore, developed the ability for governing outlying possessions. He is not a product of West Point, however, but he is a graduate from the Harvard Medical School, and he attained his present great position through his natural qualities.

A contrast to that lies in the building of the Panama Canal, which required not so much leadership as authority and executive ability of high order. The early organization in Panama was probably much influenced by John Stevens. But the carrying out of the work was extremely well done by an able executive who had authority from Congress and from the President of the United States to employ the men necessary on the Isthmus. Failing authority, leadership is of not much use, excepting as invention and thought may be handed down through the generations to some future leader or executive. A splendid example of that is found in the work of Eli Whitney who may or may not have been a leader of men. He was probably not, but he did invent the cotton gin, which had such a tremendous influence on the history of the United States during the first half of the nineteenth century. He also left as a heritage to us the infant, production management. Many years passed before that came to fruition at the

hands of a former president of the A. S. M. E., F. W. Taylor. His investigation in the cutting of metals and his working out of scientific management were both masterpieces. It makes no difference that time has changed them and given us a better view of both. The fact remains that he was a great leader.

There is a real distinction between the two words *leader* and *executive*. I would like to bring this out at the risk of repeating what has already been said in the meeting of this Society. To take a few other examples, I would cite Louis Pasteur as another great instance of leadership through thought and investigation. He has probably had a wider influence on the future of the human race than any other man of his day, and I doubt if he had any of the qualities of executive, or if any of his work was really influenced by his former teachers. In General Gorgas, we had a great executive. The leader in connection with tropical diseases was Dr. Reed, who made investigations at Havana through the cordial coöperation of General Wood, who was then Governor-General of Cuba.

I had the good fortune to go through the Culebra Cut with Rourke, who had been in charge of it as a civilian replaced by an army officer after the work was well organized. In that trip through the Canal I had an example of a real leader. He had been away from the Canal in charge of public works for a number of years, and, as we walked through the Cut, everyone stopped to salute him, even the men came down from the towers, and the trains stopped to allow the crews to shake hands with him. His work had been executive. Nevertheless, he had the qualities of a leader and the men knew it. It is not necessary for me to cite Herbert Hoover. We know about him as a leader of men and earlier in his life as a good executive. Again I say that we ought not to confuse the word with something else. Generally a leader is not a great executive, and leaves to someone else to perfect an organization. The foundation of the Christian religion is a perfect example of

that. Without St. Paul it is doubtful if the life of Christ could have survived in our records.

We ask ourselves how far the teacher can assist in leadership, when, as a matter of fact, we generally mean how far can the teacher prepare men to take their places as executives in our great industries. Executives can be trained. I doubt if the leaders are the products of any schools. Abraham Lincoln certainly was not, and one might well doubt if Theodore Roosevelt was made by Harvard College. Civil institutions would find it difficult to train men, even for executive positions, simply because they have no discipline behind them, except in the satisfactory fulfillments of requirements in studies. Most colleges find a genuine training for leadership on the athletic fields. That is the chief argument for football. It is possible, however, that it is not the training for leadership, but that the leaders come forward to occupy positions of responsibility. I have seen so many instances of that, that I am convinced leadership is not taught. A sense of responsibility and of discipline and of thoroughgoing performance of work will always make a good executive, and he can be taught.

The engineering profession is sound in its citizenship, but I think there is some tendency on the part of teachers and their students to yield to the loose claims of reformers. A true leader is only the gate-opener to larger fields. Without him the human family would be a failure, but the reformer is rarely a leader. At the present time we are listening to too much propaganda on property. The doctrine of destruction as practised in Russia is all very well on the principle that you must clear the field before anything can be planted, but it is false to the core when we come to the facts in the case. It is possible that a city burned down may come back beautified and healthful. That is the main argument for the destruction of government, but recovery of a city or a government in modern times implies the survival of industries and ideals necessary to restore it. If everything be destroyed, it is like the complete wiping out of the forests, where there can be

no recovery except in the long process of the centuries, simply because there is no source of regeneration.

There must always be outstanding figures in government and in wealth. The possessor of great wealth is always put down by the reformer as an evil influence. That may or may not be true. It will depend naturally upon the use to which his wealth is devoted. On the whole, Mr. Carnegie's money has justified itself, and we who benefit in colleges know that well enough. So long as financial leaders help society and help education, they are really holding their fortunes as a public trust, and they are the finest types of citizens and leaders to whom our government may look for support and for encouragement in democracy. Has any citizen ever done as much for society by breaking things down as have the great builders of fortunes accomplished by building up?

Where do the teachers come into all this? I am trying to answer this for engineering through the question about the learned professions asked at the beginning of this address. It is the teacher's task to plan the curriculum by which young men learn the truth about society and the means by which they are to serve it. Our true leaders must grow through learning and character. Therefore, the young graduates must not go out of our engineering colleges ignorant of the history of their profession, of its place in modern life and of the means by which civilization is promoted. Are they, then, to aspire to learning? I do not see how it can be otherwise in spite of the rough classification that has been placed upon us by society, that we are more or less the toilers. We must know history if we are to serve on the outposts of civilization against the raids of the fanatics.

The answer to any question, is engineering a learned profession, requires a bit of definition, as it will turn largely upon the meaning of *learned*. Engineering is here taken to mean the art of producing all things to satisfy human needs; not of producing things that grow, but of those that are made by the hand. It is, like all other professions, divided into two parts; those which are properly called professional, and those

which demand only training with the hand for such practical application as is necessary to do the routine work. In other words, there are represented the officer and the private. Our question relates to the officer. Does he belong to a learned profession? This word is so carelessly used that we do not know exactly what is meant. There is the learned teacher, a learned judge and a learned pig. To the mind of a professor who has spent his life in folk tales and myths, the plain business man is outside of the pale; the former is always treated as a learned man and the latter as a money-grubber. The dictionary definition justifies this distinction; "having a profound knowledge gained by study, especially in language or some department of literary or historical science." In this sense, learning is a test of memory, and the engineer is not a learned man. There are two very distinct types, the men of action and the men of study. All professions contain a greater or smaller number of men whose occupation is of an executive character and others who spend their time with books.

The practice of a profession is, in general, technical, and we get away from learning the instant we become men of action. I know very well that we have certain professions called learned, but let us analyze them to see wherein they differ essentially from engineering. The practice of law is technical, so technical in fact that it is mainly based on precedent or on rules interpreted by the courts. Even the taking of evidence is by well established procedure with which the lawyer must be familiar. The decisions are based on precedent or statistics without entire regard to abstract justice, however much a judge may desire to hold the even scales. It is for that reason that justice is looked upon as blind. The decisions of the courts are not made in accordance with human needs or with the social changes excepting so slowly that we never get away from the technicalities. In the main, law is progressive, but centuries pass before great changes are accepted except by statute. Law is thought to be more human because a lawyer may win a case by the tricks of an actor or

by taking advantage of the opportunities against a less skillful advocate without much regard to justice. It is true that the rules of the law are gathered from human beings, while the rules of engineering are taken from inanimate objects. These are much more exact and clear and they are never under the influence of men. Still, the law is a technical profession, notwithstanding that its technicalities differ from those of engineering.

The medical profession has become more technical with the advance of science. The old country doctor is slowly disappearing and in his place has come the specialist. Half a dozen doctors with their specialities are required to replace the one old-fashioned "friend of the family" who practiced medicine. We do not know that the race is any better or any happier, notwithstanding the fact that infectious diseases are less fatal than they used to be. We do know that medical practice has become more and more in accordance with rules set down by scientific investigation.

The teacher is apparently emancipated to some extent and yet he has his rules and his success is, to a moderate extent, dependent upon his technical methods. When an ancient colleague of mine tells me that we cannot understand English literature without learning Greek, he is talking technical nonsense. Most of our literature has been produced by men and women who know little or nothing about Greek, and care less about it. It may be true that many words would be more clearly understood and more accurately used if traced back to their origins, but that has nothing to do with the traditions that have influenced us in our writings and in our Government. Furthermore, human thought has not changed much since the Greek and we might, as English, learn something from the literature we have derived from them, but that something is not necessary. It is a question whether the Anglo-Saxon owes anything to Greece. All that we can say is that it is the road by which men have come. We cannot prove that there was not a better road that we could have taken. I believe that the teacher of engineering is somewhat

nearer the truth in his relation to his students, for he is likely to be more modest in his claim as to the value of what he teaches. He knows what is technical as distinguished from what is human, and he confesses that there is a difference between the two.

The advance in civilization is measured first by material things and then by thought. That thought is not language, although it must necessarily be expressed by language. A Chinaman and an American may be thinking out the same human problem without a single word in common.

One of the greatest mistakes made by the man in the street relates to technical education. He calls it "that sort of education which is especially adapted to the needs of men whose business in life it is to pursue some kind of handicraft." It is vastly more than that. Such definitions as this afford a good reason why the engineering profession is misunderstood, and why no one ever thinks of learning or leadership in connection with it.

Human life on this planet is affected from two directions.

1. That which keeps the race alive.

2. That which adds to life's satisfactions, well-being and happiness.

The first of these is an absolute necessity for all men and by it the individual is subject to the same laws of evolution as the wild animals in the fields. We call it, in daily conversation, making a living. It might better be described as rendering that service to the community which entitles a man to his living in order to free him from becoming a public charge. The second of these points applies more to the social group, because the individual may live while the group dies. It involves much of the technical science in order that society may hold together in our modern century.

We are too much given to exaggerated statements about the humanities and about learning. That is the chief difficulty with our educational system today. Much has recently been said about an aristocracy of learning and about the great number of young people who go to college and yet who are

unfitted for the education to be obtained through college. If it is true that we ought to select men to go to college by some rules, it is equally true that our education must be to blame where girls and boys are to be turned out from the same mould, in the same shape, usually spoiled as to their individuality. The real fact is that preparation for the practice of a profession or an occupation is very largely technical and the human element is only to teach men how to be better citizens. Our educational establishments are narrow, limited, and are in the end unable to devise the kind of education that would fit each individual. I think that is the main trouble with all this discussion through which educators are passing. Every youth ought to take the highest education that he can in the direction wherein his maximum possibilities will be exerted. It is nonsense to take the children of any community and teach every one of them exactly the same thing. Yet that is what our colleges try their best to do, and even our engineering schools are faulty in that regard. That is not learning, it is bigotry and a lack of power in modern society.

We as a profession have not a good start in the humanities and our training lacks the stimulus towards a higher place in society. The difference between engineering and all the other professions is in this very stimulus. The law, while technical, is dealing mainly with human relations. Engineering, while technical, is mainly directed towards the use of dead material. This industrial century is changing that, if we are alive to our opportunities, and if the teachers can only direct the attention of students towards this widening field. The professional schools of law and medicine and the ministry have in general committed themselves to a better preparation through the Bachelor's degree as a preliminary to study their profession. They thus obtain a better start towards high and broad attainment. One fact we must recognize. Our own profession can not safely wander too far into byways of learning. A young man graduating from an engineering college must not have become impatient with the details and technicalities of his daily occupation. We observe some of this

tendency in the unwillingness of young Americans to enter drafting rooms and workshops. They are likely to drift off into sales branches of our industries.

Leadership is all really a question of the teacher's place in the industries. How well are we informed about the problems that will have to be solved during the twentieth century? They have grown out of the inventions of the nineteenth century, which I have called the second great and striking century of human history. What is it to lead to? Are we going down hill in the course of the next two or three centuries, in exactly the same way as the Greeks, the victims of a great attack upon liberty similar to that of Germany, or a greater attack by the yellow races? That will depend upon us and our power of leading students into thought and understanding of what our century is going to demand. This week at Cornell has been put into what seems to me really the possibility of a higher service to humanity. We talk much about that and we make but little more progress than our ancestors made one hundred years ago, when they discussed exactly the same thing.

Let me direct attention to a remark made by one of my friends who spent five years during the war in the management of Siberian railways. He went with Stevens in a party to Siberia and was in Omsk during the time the Russian people and the Czecho-Slovaks fled before the Reds. He says: "The American people have built up the greatest transportation machine in the world, producing transportation at the lowest rates in the world, on the simple rule that promotion depends entirely upon the capacity for responsibility. The Russian Governmental Railway machine depends on building up its personnel on an elaborate system of educational requirements, civil service and seniority rules which produce transportation at twice the American cost, with a labor cost per man hour of one third the American. American general administration expense is 4 per cent. of the total operating expense. Russian similar cost varies from 15 to 30 per cent." That is what springs out of an elaborate civil service under

governmental control. It indicates, however, why American railways have been so successful under the management of men of action rather than men of learning. Have they been intelligent enough, however, to anticipate what the future will bring to our transportation system? I think not.

In all our discussion we ought to face the truth, so far as we can understand it. I do not wish to wander off into the vagaries, but rather to outline the facts as we know them in education towards understanding the true place of our engineering schools. I confess that I am not satisfied with the attainments of engineers in general subjects. They are learned in the facts of their own profession and unlearned in its relation to a great development of civilization and to the relation of their own science to other subjects. The chief obstacle to a clear general agreement on the place of engineering lies in disagreement on the facts of education. If we take the average graduate from an engineering school as a fair representative of the profession, I fear that we must confess to a lack of culture in those subjects that would be highly valuable as literary resources and enable us to represent ourselves better before the public. It is not that engineering lacks good citizenship, it is not that it lacks character. I believe that it possesses both of these to a higher degree than most professions, as engineers have a very high sense of duty in their work, totally unlike law and medicine. They feel a sense of disgrace if they lose a structure or a machine through failure of part. If a lawyer loses a case, it is, after all, only one man against another, and one of them must fail. But, with an engineer, it is a man against matter, and he must not fail.

I may close this by asking several questions, which I shall not try to answer here, leaving them for the thought of this Society.

1. Would an engineer do his work better, if more learned, either in the history of his profession or in the facts that lie in the textbooks today?

2. Would he be a more useful citizen, if more learned, especially in history and economics?

3. Would he derive greater satisfaction from his work? Of course we know men derive greater satisfaction from their work, if they are more intelligent. But success is part of satisfaction, and, if, through too much study of history and the humanities, an engineer fails of attainment in his science, he can not feel satisfied.

Let this not lead to a misunderstanding. I think that every engineer ought to have a good general education, and that he ought to enjoy the best things that have been produced by our race. The only point yet to be observed, however, is that he must learn to practise his profession well, and he can not feel satisfied if through knowing a lot about the humanities, he fails to build a good bridge. Hence the appeal for higher education does not at all mean a neglect of the technical side of the profession or a neglect of the practical leadership of men.

There is one consideration that I wish to add. The tendency towards specialization usually appearing in the elective system of colleges is away from learning. Any kind of intensive study without reference to its relation to other subjects is likewise away from learning, and from a better understanding of the subject studied. Teachers of Greek who have kept to the one subject without much reference to modern times and modern society and modern spirit are extremely narrow. With it they carry a large conceit as to the breadth of their education and the inferiority of this generation. On the other hand, a modern college man who has no knowledge of the classical language and history is so dwarfed that he can not understand the problems of his own times. A good general education depends to a very large extent upon proscription or compulsory system. It is sometimes stated that students succeed best in the things they choose out of a great variety of offerings. The trouble with that theory is that very few young know what they want to study in college. Sometimes they flounder around so much that they are worse

off than young men who aim to make studies fit into the athletic or social requirements of the times. In this respect an engineering college is better off, even though it does not open the way to learning, except in that restricted sense that means accumulation of facts.

After all is said, an inspiring and devoted teacher is the true measure of success in teaching. He is a natural leader and by example he can teach leadership, not through books but through the character that he is enabled to assist students in building up. If he has the power to stimulate thought and activity in his subject, he is setting his disciples in the way of learning. If he has the power to inspire good citizenship, he is helping to form leaders. Few teachers of engineering ever get beyond the routine of mechanical recitations. It follows from this fact that the education of our men usually ceases after their graduation. I can not suggest a remedy here excepting that every teacher shall learn to like his students and the service that he is rendering. That is a measure of leadership, and it is through that alone that a teacher can serve as we desire him in making our profession greater.

MINUTES OF THE MEETINGS OF THE COUNCIL HELD AT CORNELL UNIVERSITY, JUNE 20, 22, 23, 1923.

Members in attendance: D. S. Anderson, E. J. Babcock, W. N. Barnard, Ed. Bennett, F. L. Bishop, H. S. Boardman, G. R. Chatburn, M. E. Cooley, J. H. Dunlap, H. S. Evans, J. H. Felgar, O. J. Ferguson, F. A. Fish, F. E. Giesecke, A. M. Greene, J. F. Hayford, F. G. Higbee, E. A. Hitchcock, C. S. Howe, D. C. Jackson, H. S. Jacoby, D. S. Kimball, O. M. Leland, F. W. McNair, C. E. Magnusson, J .F. Merrill, Hugh Miller, W. G. Raymond, C. F. Scott, F. E. Seavey, G. C. Shaad, W. H. Timbie, F. E. Turneaure, P. F. Walker (34).

President Scott presented in detail the progress made by the Board of Investigation and Coördination and also presented the plans for the future work of that Board.

The report of the Secretary was presented and upon motion accepted. This report contained a resume of the activities of the Development Committee and the Board of Investigation and Coördination.

The Council passed the following resolution:

"*Resolved*, That the Council of the Society for the Promotion of Engineering Education approves most heartily the program suggested by the Board of Investigation and Coördination and pledges collectively and individually its most cordial and active support to the efforts of the Board."

The following actions were taken in connection with the Board and its work:

1. That the Board be given authority to add to its number two (2) members.

2. That the President of the Society be a member of the Board, Ex-Officio.

3. The term of J. H. Dunlap having expired, upon motion, he was elected a member of the Board for five years.

4. That the Board has the authority to change the name, provided a name satisfactory to the members of the Board can be found. (This change was deemed advisable due to the length of the name of the Board.)

5. That each member of the Council submit names of men to be considered by the Board in its choice of a Director.

6. *Resolved,* That the Council of the Society for the Promotion of Engineering Education authorize the President in the name of the Society to invite the four founder engineering societies and such other national engineering societies as may be designated by the Board of Investigation and Coördination to appoint counselors from their respective societies for assistance with the Board of Investigation and Coördination.

Other actions taken were:

1. Invitations to hold the 1924 meeting were received from the following institutions: State University of Iowa, University of Colorado, and the University of Utah. The University of Colorado was selected as the meeting place for 1924 upon ballot.

2. Dean H. S. Evans, University of Colorado, was instructed to invite the heads of preparatory schools in and near Boulder to the 1924 meeting, the invitation to be on behalf of the Society.

3. A committee of three was appointed to revise the Constitution and By-Laws. This Committee on Revision of the Constitution is composed of W. G. Raymond, *Chairman,* Charles S. Howe, and C. C. Williams.

4. The Secretary was instructed to send a letter to each member of the Society who is in arrears $10 or more and upon the receipt of this amount, they be placed in good standing upon the rolls of the Society. Failing to take advantage of this offer within a reasonable period, these members will be dropped from membership in the Society.

5. Members in arrears six (6) months will forfeit their right to receive the publications of the Society—ENGINEERING EDUCATION and *Proceedings.*

6. The Secretary was instructed to notify the American Association for the Advancement of Science that the Society for the Promotion of Engineering Education withdraws as an affiliated member of that body.

7. Hugh Miller was elected as the third member of the Committee of this Society to coöperate with the American Council on Education. The other members are C. J. Tilden and F. L. Bishop.

8. Adopted the recommendation of the Committee on Drawing that the occupational classification of the year book be changed from "Machine Design and Drawing" to "Drawing and Design"; and that the "Committee on Drawing" be called the "Committee on Drawing and Design."

9. The following budget for 1923–24 was adopted:

Receipts:		
Current dues, individual		$7,160.00
Current dues, institutional		935.00
Back dues		1,000.00
Advertising		2,000.00
Sale of publications		300.00
Total estimated receipts		$11,395.00
Disbursements:		
A. Cornell meeting	$400.00	
B. Proceedings, Vol. 31	1,500.00	
C. ENGINEERING EDUCATION, Vol. 14	4,000.00	
D. Committee expenses	150.00	
F. Secretary's honorarium	1,000.00	
H. Clerical assistance	1,800.00	
I. Sundry printing	300.00	
J. Postage and expressage	200.00	
K. Telephone and telegraph	50.00	
L. Office supplies	50.00	9,450.00
Estimated surplus		$1,945.00

10. The following members were approved for election by the Society. (Approved later by the Society.)

Bureau, Ernest A., Assistant Professor of Electrical Engineering, University of Kentucky, Lexington, Ky.

Burrows, Earle N., Assistant Professor of Bridge Engineering, Cornell University, Ithaca, N. Y.

Bush, Vannevar, Professor of Electrical Power Transmission, Massachusetts Institute of Technology, Cambridge, Mass.

Carlovitz, Giles Homer, Instructor in Electrical Engineering, Vanderbilt University, Nashville, Tenn.

Correll, James A., Associate Professor of Electrical Engineering, University of Texas, Austin, Tex.

Craig, Dudley P., Instructor in Mechanical Engineering, Purdue University, Lafayette, Ind.

Crosby, Wm. A., Instructor in English, Massachusetts Institute of Technology, Cambridge, Mass.

Dawson, Francis M., Associate Professor of Mechanics, University of Kansas, Lawrence, Kans.

Drisko, William J., Professor of Physics, Massachusetts Institute of Technology, Cambridge, Mass.

Ellis, H. M., Professor and Head, Dept. of English, University of Maine, Orono, Me.

Geiger, John W., Instructor in School of Mechanical Engineering, Purdue University, Lafayette, Ind.

Hale, Charles, Associate Professor of English, Rutgers College and State University of New Jersey, New Brunswick, N. J.

John, Walton C., Specialist in Rural and Technical Education, U. S. Bureau of Education, Washington, D. C.

Johnson, E. D., Instructor in Electrical Engineering, University of Pittsburgh, Pittsburgh, Pa.

Lafreniere, Theo. J., Sanitary Engineer, 59 Notre Dame East, Montreal, Canada.

Laton, Thomas J., Assistant Professor of Drawing, University of New Hampshire, Durham, N. H.

McCaugley, Wm. J., Professor of Mineralogy, Ohio State University, Columbus, O.

MacKinnon, Lee W., Director of Junior College, University of the City of Toledo, Toledo, O.

Mao, Thomson E., Dean of College of Engineering, National Southeastern University, Nanking, China.

Pearson, Henry G., Professor of English; Head Dept., English and History, Massachusetts Institute of Technology, Cambridge, Mass.

Pond, Miles A., Associate Professor in Civil Engineering, Cornell University, Ithaca, N. Y.

Sears, Stephen F., Instructor in English, Massachusetts Institute of Technology, Cambridge, Mass.

Stovall, Samuel C., Jr., Instructor, Georgia School of Technology, Atlanta, Ga.

Thorogood, Brackett K., Educational Counselor, Franklin Union, Boston, Mass.

Vogel, Frank, Professor of German, Massachusetts Institute of Technology, Cambridge, Mass.

Warren, Charles H., Professor of Geology, and Dean of Sheffield Scientific School, New Haven, Conn.

National Southeastern University, Nanking, China.

Respectfully submitted,

F. L. BISHOP,
Secretary.

MINUTES OF THE THIRTY–FIRST ANNUAL MEETING. CORNELL UNIVERSITY, ITHACA, N. Y., JUNE 20–23, 1923.

The thirty-first annual meeting of the Society for the Promotion of Engineering Education was held at Cornell University, Ithaca, N. Y., June 20 to 23, 1923. The sessions were held in Goldwin Smith Hall. There were 350 in attendance. The keynote of the meeting was *Training for Leadership.*

Minutes of the Regular Sessions.

Wednesday June 20.

Opening Session.

The meeting was called to order at 2:00 P.M. by the President, Charles F. Scott, Professor of Electrical Engineering, Sheffield Scientific School of Yale University. The first paper was presented by Dexter S. Kimball, Professor of Industrial Engineering and Dean of the College of Engineering, Cornell University. Dean Kimball sounded the keynote of the meeting in his paper "Training for Leadership." President Scott then made a report on the activities of the Development Committee and the Board of Investigation and Coördination, and the function of the Board in training for leadership. This was followed by the members of the Board, J. H. Dunlap, M. E. Cooley, F. W. McNair and D. C. Jackson. Each member took a specific phase of the work and discussed it.

In the absence of J. Raleigh Nelson, Chairman of the Co-Operating Committee of the University of Michigan, L. A. Hopkins read the report of that Committee. This report was followed by a discussion of the reports of both the Committee and the Board.

The following resolution was adopted:

Resolved, That the Society in convention assembled express

its appreciation and approval of the activities and plans of its President and its Development Committee, and endorse their actions, and pledge the support of its individual members to the proposed program of investigation of engineering education.

Dean A. A. Potter, Chairman of Committee No. 5, Membership, made the report for that Committee and Dean F. L. Bishop gave his report as Secretary of the Society.

The President appointed the Committee on Resolutions composed of Douglas Anderson, Chairman, H. S. Boardman and J. F. Merrill.

Thursday June 21.

Second Session.

The second session of the meeting opened at 10 A.M. and T. H. MacDonald, Chief of the Bureau of Public Roads, read his paper on "The Engineer as a Leader in Public Service." This was followed by "The Engineer as a Leader in Transportation" by E. H. Lee, Vice-President and Chief Engineer of the Chicago and Western Indiana Railroad Company and the Belt Railway of Chicago; and "The Engineer as a Leader in Industry" by Oliver S. Lyford representing the National Industrial Conference Board. Discussion.

Third Session.

This meeting was called to order by Vice-President F. G. Higbee in Room A, Goldwin Smith Hall. A. H. Blanchard, Chairman of Committee No. 15, Civil Engineering, reported for that Committee, followed by the report of Committee No. 14, Business Training. W. E. Wickenden read his paper, "The Engineer as a Leader in Business," and the meeting adjourned for an inspection of the University.

Friday June 22.

Fourth Session.

Before the opening of the fourth session, Professor V. Karapetoff gave a lecture on "Einstein's Theory of Relativity."

The report of Committee No. 16, Electrical Engineering, was read by H. E. Dyche followed by his paper on "Fundamentals." Discussion. "Engineering Courses for the Functional rather than the Industrial Divisions of Engineering" was presented by Edw. Bennett. Discussion. The report of the Treasurer was read and approved.

Fifth Session.

The fifth session was called to order by President Scott and L. S. Marks presented his paper, "A Combined Five-Year Course in Engineering and Business Administration." Discussion. G. O. Frampton read his paper, "Leadership in Industry," followed by W. C. John with "Analysis of the Attendance at Engineering Schools."

O. J. Ferguson reported for Committee No. 8, Admissions; Secretary Bishop, in the absence of the members of Committee No. 16, Mechanical Engineering, read their report of progress; and F. W. Sperr reported for Committee No. 18, Mining.

The Nominating Committee reported as follows, the Secretary, upon motion, casting the unanimous vote of the Society:

President: P. F. Walker, University of Kansas.

Vice Presidents:

H. S. Boardman, University of Maine.
O. J. Ferguson, University of Nebraska.

Secretary: F. L. Bishop, University of Pittsburgh.

Treasurer: W. O. Wiley, John Wiley & Sons, Inc., New York.

Members of Council:

D. S. Anderson, Tulane University.
F. E. Seavey, Tufts College.
E. J. Babcock, University of North Dakota.
Hugh Miller, George Washington University.
H. C. Berry, University of Pennsylvania.
F. A. Fish, Iowa State College.
W. N. Barnard, Cornell University.

The Institutional Committee reported as follows:

Resolved, That the representatives of institutional members of the Society for the Promotion of Engineering Education do approve most heartily the program of procedure developed by the Board of Investigation and Coördination and recommend emphatically that all institutional members cooperate to the full with the Board in the execution of its program.

The Division of Deans and Administrative Officers reported as follows:

The Division of the Society for the Promotion of Engineering Education, composed of deans and administrative officers of engineering schools and colleges, having before it the proposed program of the Board of Investigation and Coördination for the conduct of its work, approves that program unreservedly and pledges its support to the Board and its best endeavor to secure such individual and united faculty coöperation that may be desired by the Board.

Saturday June 23.

Sixth Session

President Scott opened this meeting at 10:30 and Ira N. Hollis presented his paper "The Teacher's Place in Training for Leadership"; Roy Kegereiss with "Laboratory Instruction in Engineering"; and G. W. Munro "Thermodynamics at Purdue." The report of Committee No. 12, English, was presented by Miss Sada A. Harbarger, the report of Committee No. 19 by R. S. Kirby, the report of Committee No. 6, Sections and Branches by F. C. Bolton, and Committee No. 21, R. O. T. C. by P. F. Walker. Major Lanahan of the War Department expressed the appreciation of that Department of the coöperation of this Society with them. The Secretary presented the approval of the Council on the applicants for membership. The Society elected these to membership.

(See Minutes of Council Meetings.)

The Committee on Resolutions reported as follows:

WHEREAS the Society for the Promotion of Engineering Education has held its thirty-first annual convention as the

guest of Cornell University and has been the recipient of its very cordial hospitality, expressed in the many and excellent arrangements for the comfort, convenience and pleasure of the members and their guests, be it, therefore

Resolved that the Society extend its sincere appreciation and thanks to President Farrand, Dean Kimball, Professor Barnard, the members of the various committees, and the ladies of the faculty for their effective coöperation which has resulted in making this one of the most interesting and successful conventions ever held by the Society.

Cornell University with its magnificent campus, its fine traditions and its charming social life, will always remain a bright spot in our memories. And be it further

Resolved that the members of this Society extend their earnest and hearty appreciation to retiring President Charles F. Scott for his untiring and effective efforts which have resulted in giving a new impetus to the Society and a constructive program for its future activities.

H. S. Boardman,
J. F. Merrill,
Douglas Anderson,
Committee on Resolutions.

Secretary Bishop: Gentlemen, I have worked with President Scott two years and he has done a whole lot more than you know and I would like to propose that, in addition to those words in the resolution, we extend to him now a rising vote of thanks. (The vote unanimously given.)

There being no further business the new President, P. F. Walker, closed the meeting.

F. L. Bishop,
Secretary.

COUNT RUMFORD
1753-1814

Born Benjamin Thompson in Massachusetts. Charged with being a Tory, went to England, and became Under-Secretary of the Colonies. Later, in Bavaria reorganized the military department and was made Count Rumford. Returned to England and engaged in scientific research. Founded the Rumford professorship at Harvard.

He watched the pot as it boiled

Thousands of people had watched th boiling pot, but Count Rumford wo dered *why* it boiled. He did more tha wonder; by scientific research he fou out for himself.

And Rumford laid the foundation the greatest generalization the huma mind has yet conceived—the law the conservation of energy.

Scientists in the Research Laboratori of the General Electric Company a devoting their lives to pure researc carrying on the work of Rumford a other pioneers of modern science. B methodical investigation, the fronti of scientific knowledge is being push steadily forward.

The General Electric Company, by continuous scientific research, has developed new and better ways of making electricity of use to mankind.

GENERAL ELECTRI